

**DEPARTMENT OF MECHANICAL ENGINEERING  
NATIONAL INSTITUTE OF TECHNOLOGY  
KURUKSHETRA-136119**



**SCHEME AND SYLLABI  
OF**

**B. TECH. (ROBOTICS & AUTOMATION)  
3<sup>RD</sup> SEMESTER**

**(FOR STUDENTS ADMITTED IN ACADEMIC YEAR 2024-25)**

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**SCHEME OF EXAMINATION**  
**B. Tech. Robotics & Automation 3<sup>rd</sup> Semester**

| CODE     | COURSE                                           | L | T | P | Credits   |
|----------|--------------------------------------------------|---|---|---|-----------|
| MAIC 201 | Discrete Mathematics and Statistical Methods     | 3 | 0 | 0 | 3         |
| RAPC201  | Mechanics of Machines                            | 3 | 0 | 0 | 3         |
| RAPC202  | Basic Electrical and Electronics Engineering     | 3 | 0 | 0 | 3         |
| RAPC203  | Introduction to Automation                       | 3 | 0 | 0 | 3         |
| RAPC204  | Signals and Systems                              | 3 | 0 | 0 | 3         |
| CSIC221  | Machine Learning and Data Analytics              | 3 | 0 | 2 | 4         |
| RAPC205  | Mechanics of Machines(P)                         | 0 | 0 | 2 | 1         |
| RAPC206  | Basic Electrical and Electronics Engineering (P) | 0 | 0 | 2 | 1         |
| RAPC207  | Signals and Systems (P)                          | 0 | 0 | 2 | 1         |
| SWNC101  | NCC/Sports/Yoga                                  | 0 | 0 | 2 | 1*        |
| SWNC102  | NSS/Clubs/Technical Societies                    | 0 | 0 | 2 | 1*        |
|          | <b>Total Credits</b>                             |   |   |   | <b>22</b> |

\* Continuous Evaluation Model as per guidelines and the credit to be awarded at the end of 6th Semester based on Cumulative performance up to 6th Semester

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|---------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------|
| <b>Course Code</b><br><b>MAIC 201</b> | <b>Discrete Mathematics and Statistical Methods</b><br><b>(For CS, IT and AI &amp; ML)</b> | <b>L - T - P - C</b><br><b>3 - 0 - 0 - 3</b> |
|---------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------|

### Course Objectives:

1. To give the students deeper knowledge about Probability and Distributions.
2. To study the topics of discrete mathematics with engineering applications.
3. To apply graph theory based tools in solving practical problems.
4. To impart knowledge about Statistical Methods.

#### Unit 1:

8L

**Discrete Probability:** Basic definitions, Engineering applications of probability, Set theory, Probability Multiplications principle, Product of sums principle, Cross product of sample spaces, Theorem of Total Probability, Conditional Probability, Mutual Exclusion and Independent Events, Principle of Inclusion and Exclusion, Bayes' Rule.

#### Unit 2:

8L

**Discrete Random Variable & Probability Distributions:** Random variables and their event spaces, Probability Mass function, Distribution function, Mean and Variance of random variables, Expected value of a random variable & Computation of expectation for one variable, Bernoulli's Trials & Binomial distribution, Poisson distribution, Normal distribution, Recurrence relation and their solutions.

#### Unit 3:

8L

**Graphs:** Basic Terminology, Multigraphs and Weighted Graphs, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planar Graphs.

#### Unit 4:

8L

**Relations and Propositions:** Binary Relations and their properties, Equivalence relations and partitions, Partial ordering relations, Linear ordering relations, Chains, Functions and Pigeonhole principle, Propositions.

#### Unit 5:

8L

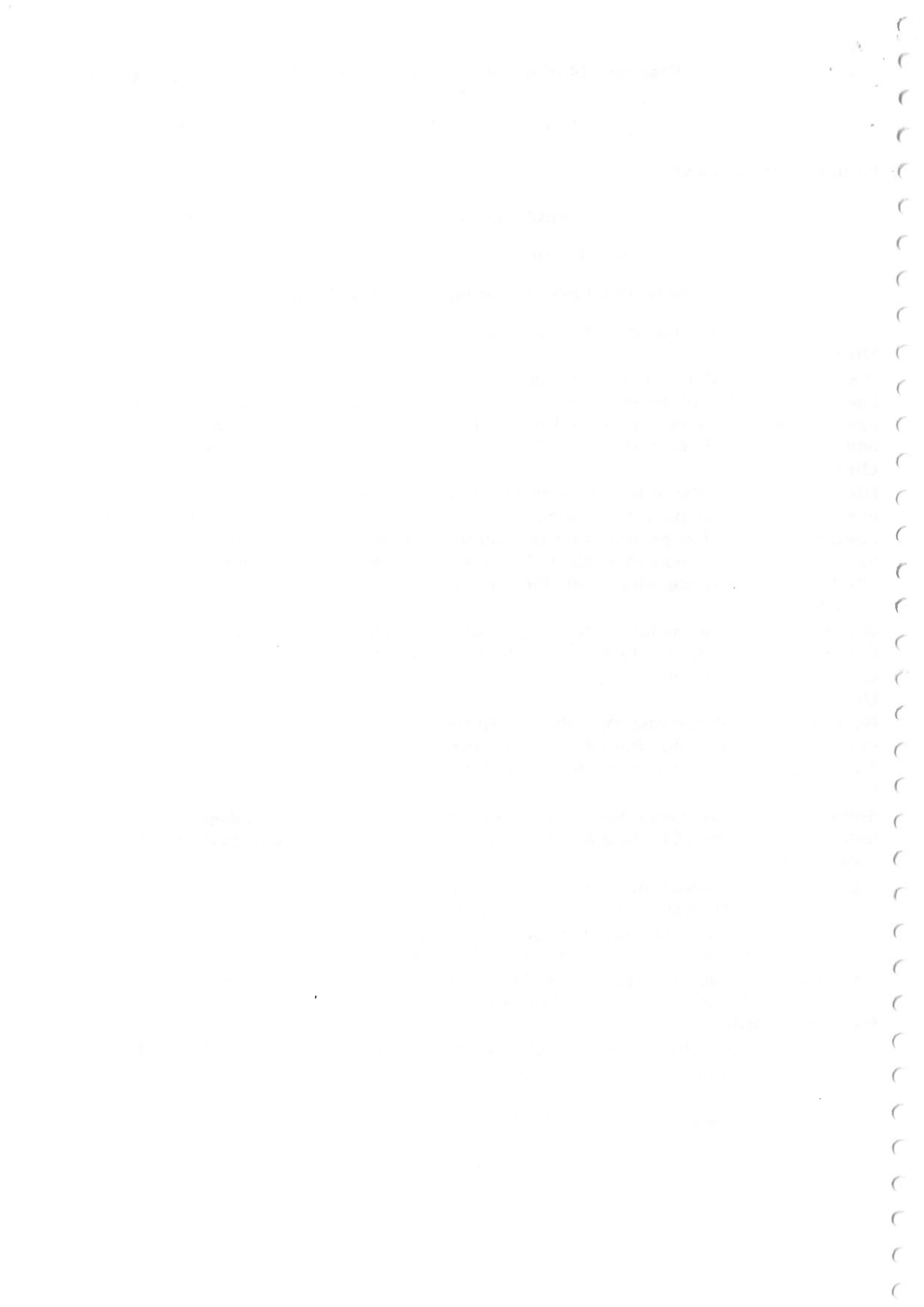
**Statistical Methods:** Large sample tests- Procedure of testing hypothesis, Small sample tests, Student's T-test, Chi-Square test, Independence of attributes and goodness of fit.

#### Text Books:

1. Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists, PHI, 2nd Edition, 2008.
2. J. P. Tremblay and R Manohar, Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw Hill, 2001.
3. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists, 9th Edition, 2012.

#### Reference Books:

1. Kolman, Bobby Ross, Discrete Mathematics Structures, 3rd Edition, PHI, 2001.
2. C.L. Liu, Elements of Discrete Mathematics, 2nd Edition, Tata McGraw Hill, 1985.
3. Gary Haggard, J. Schlipf, S. Whitesides, Discrete Mathematics for Computer Science, Cengage Learning, 1st Edition, 2005.



|                                    |                              |
|------------------------------------|------------------------------|
| <b>Course Code</b>                 | <b>RAPC-201</b>              |
| <b>Course Title</b>                | <b>MECHANICS OF MACHINES</b> |
| <b>Number of Credits</b>           | <b>3</b>                     |
| <b>Prerequisites (Course code)</b> |                              |
| <b>Course Type</b>                 | <b>PC</b>                    |

| <b>L</b> | <b>T</b> | <b>P</b> | <b>Credits</b> | <b>Total contact hours</b> |
|----------|----------|----------|----------------|----------------------------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b>       | <b>40</b>                  |

### **Brief Description about the course**

The course provides a comprehensive foundation in the principles of mechanisms and machines, focusing on their analysis and applications in engineering systems. It covers velocity and acceleration analysis to understand the motion of various machine components. Topics include static and dynamic analysis, essential for determining forces and motions in mechanical systems. The curriculum also delves into the design and functioning of cams and followers, belts, friction systems, clutches, and flywheels, which are critical for energy transmission and control. Additionally, the course explores the principles of balancing to minimize vibrations in rotating and reciprocating machinery. A significant emphasis is placed on mechanical vibrations, gear systems, and gear trains to equip students with the skills required for designing efficient and reliable mechanical systems.

### **UNIT- I**

#### **Mechanism and machines**

Introduction Kinematics, Dynamics, Introduction to analysis and synthesis of mechanisms, resistance body, link, Types of link, Kinematic pair, Type of Kinematic pairs, Joints, Type of joints (Revolute, prismatic, cylindrical, spherical, Hook's joint, Twisting joint), Kinematic chain, Mechanism, Type of Mechanism, Machine, Types of motion, Degree of freedom, Kutzbach criteria, Grubler's Criteria Types of mechanisms and their inversions.

**(5 hrs)**

#### **Velocity and Accelerations Analysis**

Velocity analysis-Introduction, Absolute and relative motion, vectors, addition and subtraction of vectors, motion of a link, Determination of velocities of link in a mechanism by relative velocity method-velocity diagram of (four bar chain, Slider crank chain, quick return Mechanism and other basic and complex mechanisms), Rubbing velocity of pin joint.

Acceleration analysis- Introduction, Total acceleration of a point in rigid link, absolute acceleration of a point in rigid link, acceleration diagram of four bar mechanism, Slider crank chain mechanism and other basic and complex mechanisms, Coriolis component of acceleration

**(9 hrs)**

## **UNIT-II**

### **Static and Dynamic force analysis**

Static force analysis- Introduction, static equilibrium, Equilibrium of members, force convention, free body diagram, principle of superposition, static force analysis of four-bar mechanism, static force analysis of Slider-Crank Mechanism.

Dynamic force analysis- D'Alembert Principle, Equivalent offset Inertia force, Dynamic force analysis of Four-Bar Mechanism, Dynamic Force Analysis of Slider-Crank Mechanism

**(9hrs)**

## **UNIT-III**

### **Gears and Gear Trains**

Types of gears, gear terminology, condition for correct gearing, cycloidal and involute profiles of gear teeth, pressure angle, path of contact, arc of contact, interference, minimum number of teeth to avoid interference. Simple, compound, reverted and epicycle gear trains

**(4 hrs)**

### **Cam & Follower**

Types of cams and followers, various motions of the follower (SHM, Uniformly accelerated and decelerated), Construction of cam profiles, Analysis for velocities and accelerations of tangent and circular arc cams with roller and flat-faced followers

**(4 hrs)**

## **UNIT-IV**

### **Balancing & Mechanical Vibrations**

Balancing-Static and dynamic balancing of rotating parts

Mechanical Vibrations- Introduction to Mechanical Vibrations, free and forced vibrations with and without damping for single degree of freedom systems, forced vibrations due to rotating and reciprocating machine elements

**(4 hrs)**

### **Friction, belt drive and flywheel**

Friction-Types of friction, Laws of dry friction, Motion along inclined plane, Screw threads, Screw jack, Wedge, Pivots and collars, Plate and cone clutches

Belt Drive-Open and crossed belt drives, velocity ratio, slip, material for belts, length of belt tensions, centrifugal tension, power transmitted by belts.

Flywheel- Turning moment diagram for single cylinder engine, coefficient of fluctuation of energy, coefficient of fluctuation of speed flywheel and its function

**(5 hrs)**

### **Course outcomes:**

At the end of the course students will be able -

CO1: To analyze and design mechanisms, and construct velocity and acceleration diagrams for mechanical systems to understand their motion behavior.

CO2: To enable students to analyze and solve forces in mechanical systems under static and dynamic loading conditions.

- CO3: To equip students with the ability to analyze, design, and apply gears, gear trains, cams, and followers in mechanical systems for efficient motion transmission.
- CO4: To enable students to understand and apply the principles of balancing rotating machinery and analyze mechanical vibrations for improving system performance and stability.
- CO5: To understand and apply the principles of friction, belt drives, and flywheels to analyze, design, and optimize mechanical systems for efficient energy transmission and regulation.

**Text Books:**

1. Jagdish Lal, Theory of Mechanisms & Machines, Metropolitan Book Company Pvt. Ltd.
2. R.S. Khurmi and J.K. Gupta, Theory of Machines, S. Chand & Co. Pvt. Ltd.
3. S.S. Rattan, Theory of Machines, Fifth Edition, McGraw-Hill Education.
4. V.P. Singh, Theory of Machines, Fifth Edition Dhanpat Rai Publishing Co. Pvt. Limited.
5. Sadhu Singh, Theory of Machines, Third Edition, Pearson Education India.



|                                    |                                                       |
|------------------------------------|-------------------------------------------------------|
| <b>Course Code</b>                 | <b>RAPC-202</b>                                       |
| <b>Course Title</b>                | <b>Basic Electrical &amp; Electronics Engineering</b> |
| <b>Number of Credits</b>           | <b>3</b>                                              |
| <b>Prerequisites (Course code)</b> |                                                       |
| <b>Course Type</b>                 | <b>PC</b>                                             |

| <b>L</b> | <b>T</b> | <b>P</b> | <b>Credits</b> | <b>Total contact hours</b> |
|----------|----------|----------|----------------|----------------------------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b>       | <b>40</b>                  |

### **Brief description:**

Aims to the basic understanding of electrical components, basic circuit analysis, AC and DC circuits, and basic construction and operation of DC machines, transformers, and three-phase induction machines. This course also equips students with the ability to understand the operation of diodes, BJT, and FET. The course also covers the basics of measurement and instrumentation and usage of DSO.

### **Course Content**

#### **UNIT-I**

Understanding of Resistor, Inductor, Capacitor, Ohm's Law, Kirchhoff's Laws, Independent and Dependent Sources, Nodal Analysis, Mesh analysis, AC Systems, Waveforms, analysis with R, RL, LC, RLC loads, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor, series and parallel resonance.

**(10 hrs)**

#### **UNIT-II**

Construction and Working principle of DC machines, types of DC motors and generators, EMF equation, Torque Equation, working principle and Applications of Transformer, mathematical model of transformers, Working principle and Applications of three-phase and single-phase Induction Motor, Mathematical model of Induction motor.

**(12 hrs)**

#### **UNIT-III**

Semiconductor Materials: Silicon & Germanium, conduction in the electronic circuit, PN Junction Diodes, Zener Diode, their Characteristics Applications, Bipolar junction transistor, and field effect transistors: construction, operation, and their biasing, their Characteristics and Applications, design of Rectifier and Inverters circuits.

Review of number systems, binary codes, error detection and correction codes, logic gates, Combinational logic – representation of logic functions, simplification of logical expressions, De Morgan's Theorem. (8 hrs)

#### **UNIT-IV**

Classification of Electrical Measuring Instruments, Principles of operation of electrical instruments, Essentials of Indicating Instruments, deflecting torque, controlling torque, damping torque, Operating Principle of Moving Coil, Moving Iron meters, PMMC and Induction Type Instruments, Ammeter Voltmeter, galvanometer, wattmeter, Energy Meter, DSO- Block diagram- Data acquisition. (10 hrs)

#### **Course outcomes:**

**On successful completion of the course, students will be able to**

- CO1:** Understand the basic electrical parameters and solve AC circuits and DC circuits
- CO2:** Describe the construction, working principles, and applications of various electrical machines including DC generators, DC motors, transformers, and three-phase induction motors
- CO3:** Understand the role of PN junction diodes, Zener diodes, BJTs, JFETs, in electronic circuits and the properties of semiconductor materials.
- CO4:** Explain the operating principles and applications of basic measurement instruments. digital storage oscilloscopes (DSO)

#### **Text Books:**

1. D. P. Kothari, I.J. Nagrath, Theory and Problems of Basic Electrical Engineering, PHI Learning
2. V.Mittle and Arvind Mittle, Basic Electrical Engineering, Tata McGraw Hill.
3. V. K. Mehta, Rohit Mehta, Basic Electrical Engineering, S. Chand publication.
4. Robert L. Boysted, Electronic Devices and Circuit Theory, Pearson.

|                                    |                                   |
|------------------------------------|-----------------------------------|
| <b>Course Code</b>                 | <b>RAPC203</b>                    |
| <b>Course Title</b>                | <b>INTRODUCTION TO AUTOMATION</b> |
| <b>Number of Credits</b>           | <b>3</b>                          |
| <b>Prerequisites (Course code)</b> |                                   |
| <b>Course Type</b>                 | <b>PC</b>                         |

| <b>L</b> | <b>T</b> | <b>P</b> | <b>Credit<br/>s</b> | <b>Total<br/>contact<br/>hours</b> |
|----------|----------|----------|---------------------|------------------------------------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b>            | <b>40</b>                          |

### **Brief Description about the course**

This course will introduce students to the fundamental principles, technologies, and applications of automation in various industries. They will build understanding of various automation components, including sensors, actuators, and control systems. Students will gain insights into the working principles of Programmable Logic Controllers (PLCs) and their role in industrial automation. Emerging future trends in automation, such as AI-driven automation, Industry 4.0, and smart manufacturing, will be discussed to prepare students for advancements in the field.

### **UNIT - I**

#### **Introduction to Automation**

Definition and Evolution of Automation, Principles and Strategies of Automation, Basic Elements of an Automated System, Levels of Automations, Introduction to Industrial Automation, Types of Automation: Fixed, Flexible, and Programmable Automation, Challenges and Future Trends in Industrial Automation. **(6hrs)**

### **UNIT-II**

#### **Sensors and Actuation System**

Introduction, performance terminology-Displacement, Position and Proximity, Velocity and motion, force, Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing. Actuation systems: Pneumatic and hydraulic systems, directional control valves, pressure control valves, cylinders, process control valves, rotary actuators. Mechanical actuation systems: types of motion, kinematics chains, cams, gear trains, ratchet and pawl, belt and chain drives, bearings, mechanical aspects of motor selection. **(8 hrs)**

### **UNIT-III**

#### **Control Systems in Automation**

Open-Loop and Closed-Loop Control Systems, Feedback and Feedforward Control, Control System Components, Industrial Control Strategies, Introduction of Microprocessor and its Architecture, Building Blocks of, Automation System: LAN, Analog & Digital I/O Modules, SCADA System & Remote Terminal Unit (RTU). **(6hrs)**

### **Programmable Logic Controllers**

Introduction to PLCs, PLC Architecture and Components, Programming Languages: Ladder Logic, Functional Block Diagrams, Input/Output Processing and Troubleshooting, Documenting a PLC System, Timer & Counter Instructions, PLC Applications in Industrial Automation.

**(6hrs)**

### **UNIT-IV**

#### **Automated Manufacturing Systems**

Robotics in Manufacturing, CNC Systems, 3D Printing, IoT in Manufacturing, Smart factories, real-time monitoring, and predictive maintenance, Human-Machine Interface, Automated Assembly Lines and Flow Lines, Flexible Manufacturing Systems, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, and Machine Vision systems.

**(8hrs)**

#### **Future Trends in Automation**

Industry 4.0 and Smart Manufacturing, Artificial Intelligence and Machine Learning in Automation, Digital Twins and Virtual Commissioning, Sustainable Automation Solutions, and Emerging Technologies in Automation.

**(6 hrs)**

#### **Course Outcomes:**

Upon successful completion of the course, students will:

1. Understand the fundamental concepts of automation and its industrial applications.
2. Understand the fundamentals of sensors, actuators, and PLCs in automated processes.
3. Develop readiness for emerging technologies such as Smart Manufacturing, Digital Twins, and Integrating automation.
4. Analyse and apply control system principles in automation for process optimization and efficiency.
5. Evaluate different automated manufacturing systems and their role in improving productivity.

#### **Text Books:**

1. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing," Pearson Education.
2. Frank Lamb, "Industrial Automation: Hands-On," McGraw-Hill Education.
3. Olushola Akande, "Industrial Automation from Scratch", Packt Publishing.

|                                    |                            |
|------------------------------------|----------------------------|
| <b>Course Code</b>                 | <b>RAPC204</b>             |
| <b>Course Title</b>                | <b>SIGNALS AND SYSTEMS</b> |
| <b>Number of Credits</b>           | <b>3</b>                   |
| <b>Prerequisites (Course code)</b> |                            |
| <b>Course Type</b>                 | <b>PC</b>                  |

| <b>L</b> | <b>T</b> | <b>P</b> | <b>Credits</b> | <b>Total contact hours</b> |
|----------|----------|----------|----------------|----------------------------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b>       | <b>40</b>                  |

### **Brief description**

This syllabus typically covers fundamental concepts of signal processing and system analysis, with applications in robotic control, sensor processing, and automation. This course is a supplementary course for Robotic and Automation Engineers to acquire the skills to handle the ever-increasing automation in the different domains.

### **UNIT-I**

Basic definitions and terminology, Classification of signals and systems, Continuous-time and discrete-time signals, Signal operations: shifting, scaling, and reversal, System properties: linearity, time-invariance, causality, stability.

**(10 hrs)**

### **UNIT-II**

Continuous and discrete time LTI systems: response using convolution integral/sum, Properties of LTI systems, Modeling of continuous and discrete time LTI systems.

Fourier series: representation of continuous and discrete time periodic signals, convergence, properties, Application to LTI systems, Fourier transform: introduction, representation of continuous and discrete time a periodic and periodic signals, convergence, properties, Application to LTI systems.

**(10 hrs)**

### **UNIT-III**

Laplace transform and its inverse, region of convergence, relation with Fourier transform, properties, Application to LTI systems, their inter connections and block diagram.

Z-transform and its inverse, region of convergence, relation with Fourier transform, properties, Application to LTI systems, their interconnections and block diagram.

**(10 hrs)**

### **UNIT-IV**

Sampling of continuous time signals; sampling theorem, reconstruction, effect of under sampling.

Applications in Robotics and Automation: Signal processing in robotic vision and sensors, control, filtering and noise reduction in automation, Speech and image processing in human-robot interaction and various other sustainable technologies with the inclusion of some case studies from the Indian knowledge system.

(10 hrs)

### **Course Outcomes**

On successful completion of the course, students will be able to

1. Characterize and analyze the properties of CT and DT signals and systems
2. Represent CT and DT systems in the Frequency domain using Fourier analysis tools like CTFS, CTFT, DTFS and DTFT.
3. Analyze CT and DT systems using Laplace transforms and Z Transforms.
4. Practising different systems in various applications.

### **Text Books**

1. Alan V. Oppenheim, S. Hamid and Alan S. Willsky, Signals and Systems, PHI/ Pearson.
2. M. J. Roberts, Signals and Systems, TMH
3. A. Papoulis, Circuits and Systems: A Modern Approach, Oxford Univ. Press
4. R. F. Ziemer, W.H. Tranter and D.R.Fannin, Signals and Systems: Continuous and Discrete, Pearson
5. Simon Haykins and Barry Van Veen, Signals and Systems, Wiley
6. Fred J. Taylor, Principles of Signals and Systems, TMH

|                                    |   |                                        |
|------------------------------------|---|----------------------------------------|
| Course Code                        | : | CSIC 221                               |
| Course Title                       | : | Machine Learning & Data Analytics      |
| Number of Credits and L/T/P scheme | : | 4 & 3/0/2                              |
| Prerequisites (Course code)        | : | Problem solving & Programming using C  |
| Course Category                    | : | IC (CE, EE, ECE, ME, PIE, IIOT, M & C) |

### Course Learning Objectives:

1. The major goal of the course is to allow computers to learn (potentially complex) patterns from data, and then make decisions based on these patterns.
2. To provide strong foundation for data science and application area related to it.
3. To provide the underlying core concepts and emerging technologies in data science.
4. A data scientist requires an integrated skill set spanning mathematics, probability and statistics, optimization, and branches of computer science like databases, machine learning etc.

### Course Content

1. **Introduction to Data Science:** What is Data Science? Linear algebra for datascience:- algebraic and geometric view, Data Representation & Statistical Inference:- Data objects and attribute types, Types of Data, descriptive statistics, notion of probability, distributions, mean, variance, covariance, Understanding univariate and multivariate normal distributions.
2. **Data Analysis:** Probability and Random Variables, Correlation, Regression, Attribute Transformation, Sampling, Feature subset selection, Similarity measures, High-dimensional Data: - Curse of Dimensionality, Dimensionality reduction: PCA, SVD, etc.
3. **Data Visualization, Bayesian Learning& Evaluating Hypotheses:** Basic principles, Scalar, Vector, & Tensor Visualization, Multivariate Data Visualization, Text Data Visualization, Network Data Visualization, Visualization Techniques, Bayesian Approach, Bayes' Theorem, Evaluating Hypotheses- Z-test, T-test, Chi-square Test.
4. **Machine Learning (Supervised & Unsupervised Learning):** Basic concepts of Classification, k-Nearest Neighbor, Decision Tree classification, Naïve Bayes' Classifier, Linear Regression Models, Logistics Regression, Basic concepts of Clustering, K-means, Hierarchical Clustering, DBSCAN.

### Text Books:

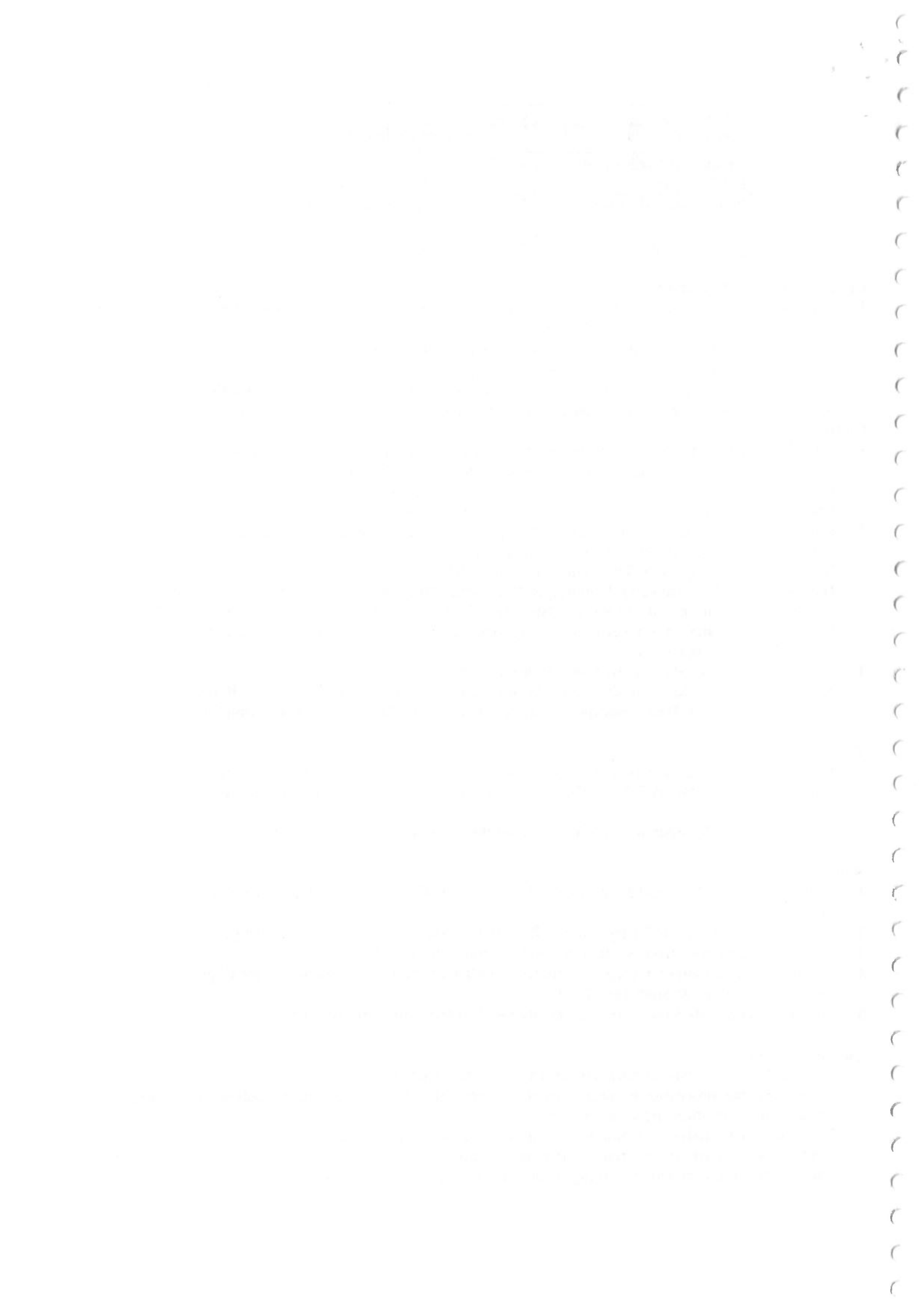
1. U Dinesh Kumar and Manaranjan Pradhan, Machine Learning using Python, John Wiley & Sons, 2020.
2. Cathy O 'Neil and Rachel Schutt., Doing Data Science, Straight Talk From The Frontline, O 'Reilly, 2014.
3. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, PHI, 2010.

### Reference Books:

1. T. Hastie, R. Tibshirani and J. Friedman., The Elements of Statistical Learning, Second Edition, Springer, 2009.
2. Christopher M. Bishop F.R.Eng., Pattern Recognition and Machine Learning, Springer, 2006.
3. J. Grus., Data Science from Scratch, Second Edition, O'Reilly, 2019.
4. Douglas C. Montgomery, George C. Runger., Applied Statistics and Probability for Engineers, Third Edition, John Wiley & Sons, Inc., 2003.
5. Tom M. Mitchell, Machine Learning, McGraw-Hill International Edition, 1997.

### Course Outcomes

1. Explore the fundamental concepts of data science and machine learning.
2. Understand the processes of data science - identifying the problem to be solved, data collection, preparation, evaluation and visualization.
3. Understand data analysis techniques for applications handling large data.
4. Visualize and present the inference using various tools.
5. Understand various machine learning algorithms used in data science process.



|                                    |                                              |
|------------------------------------|----------------------------------------------|
| <b>Course Code</b>                 | <b>RAPC205</b>                               |
| <b>Course Title</b>                | <b>MECHANICS OF MACHINES<br/>(Practical)</b> |
| <b>Number of Credits</b>           | <b>1</b>                                     |
| <b>Prerequisites (Course code)</b> |                                              |
| <b>Course Type</b>                 | <b>PC</b>                                    |

| <b>L</b> | <b>T</b> | <b>P</b> | <b>Credits</b> | <b>Total<br/>contact<br/>hours</b> |
|----------|----------|----------|----------------|------------------------------------|
|          |          | <b>2</b> | <b>1</b>       | <b>24</b>                          |

### **Brief Description about the course**

To prepare students for kinematic and dynamic analysis of various machines and mechanisms.

### **Course Contents**

1. To determine experimentally the ratio of cutting to idle time to the crank & slotted lever (QRM) & Compare the result with theoretical values. Plot the following:
  - (i)  $\theta$  v/s displacement of slider
  - (ii)  $\theta$  v/s velocity
  - (iii)  $\theta$  v/s acceleration
2. To determine velocity & acceleration of slider in Slider Crank mechanism and plot the following:
  - (i)  $\theta$  v/s displacement of slider
  - (ii)  $\theta$  v/s velocity
  - (iii)  $\theta$  v/s acceleration Compare the values of velocities and acceleration with those obtained theoretically. Assume angular velocity = 1 rad/sec
3. To determine the values of coefficient of friction between the screw & nut of jack while:
  - (i) Raising the load
  - (ii) Lowering the load
4. To draw experimentally a curve of the follower displacement v/s cam angle. Differentiate the above curve to get velocity & acceleration plot & compare the values with those obtained analytically.
5. To determine the value of coefficient of friction between belt & pulley and plot a graph between  $\log T_1/T_2$ ,  $\theta$  and measure the slip and creep in belt drive.
6. To find critical speed experimentally and to compare whirling speed of shaft with theoretical values.
7. To perform the experiment of balancing of rotating parts and find unbalanced couples and force.
8. To study various types of Gears & their terminologies – Spur, Helical, Bevel and Worm Gear.

9. To study the various gear trains: simple, compound, reverted & epicyclic.
10. To find experimentally the Coriolis's component of acceleration and compare with theoretical values.

**Course Outcomes:**

Students are able to perform the static and dynamic analysis of mechanisms.

CO1 Able to perform the experiment on various mechanisms.

CO2 To understand and illustrate various power transmission mechanisms.

CO3 Knowledge of Governors, Gears and Gear Train.

CO4 Able to perform the experiment of Coriolis's component of acceleration.

|                                    |                                                                   |
|------------------------------------|-------------------------------------------------------------------|
| <b>Course Code</b>                 | <b>RAPC206</b>                                                    |
| <b>Course Title</b>                | <b>Basic Electrical &amp; Electronics Engineering (Practical)</b> |
| <b>Number of Credits</b>           | <b>1</b>                                                          |
| <b>Prerequisites (Course code)</b> |                                                                   |
| <b>Course Type</b>                 | <b>PC</b>                                                         |

| <b>L</b> | <b>T</b> | <b>P</b> | <b>Credits</b> | <b>Total contact hours</b> |
|----------|----------|----------|----------------|----------------------------|
|          |          | <b>2</b> | <b>1</b>       | <b>24</b>                  |

### **Brief description:**

Laboratory experiments will be based on the corresponding theory course RAPC102. The updated list of experiments will be floated by the course coordinator before the beginning of each semester. Some of the tentatively suggested experiments are given below

### **LIST OF EXPERIMENTS**

1. To verify KCL and KVL.
2. To observe the amplitude and frequency of AC waveform and calculate the peak, average, and RMS values.
3. To observe the behavior of voltage and current with RL/RC/RLC loads.
4. To understand the construction of DC machine and operate the DC machines.
5. To understand the construction of three-phase and single-phase induction machines and operate the same.
6. To perform short circuit test and open circuit test on a single phase transformer.
7. To study the V-I characteristics of a diode.
8. To study the V-I characteristics of a BJT
9. To study the operation of rectifiers.
10. Measure the voltage current power in an electrical circuit using different measuring instruments available.
11. To understand the usage of DSO and read it.

### **Course outcomes:**

On successful completion of the course, students will be able to

**CO1:** Understand the basic AC circuits and DC circuits.

**CO2:** Describe the construction and operation of DC machines, transformers and three-phase induction motors.

**CO3:** Understand the role of PN junction diodes and BJTs, JFETs.

**CO4:** Understand the measurement of electrical parameters and usage of DSO.



|                                    |                                        |
|------------------------------------|----------------------------------------|
| <b>Course Code</b>                 | <b>RAPC207</b>                         |
| <b>Course Title</b>                | <b>Signals and Systems (Practical)</b> |
| <b>Number of Credits</b>           | <b>1</b>                               |
| <b>Prerequisites (Course code)</b> |                                        |
| <b>Course Type</b>                 | <b>PC</b>                              |

| <b>L</b> | <b>T</b> | <b>P</b> | <b>Credits</b> | <b>Total contact hours</b> |
|----------|----------|----------|----------------|----------------------------|
|          |          | <b>2</b> | <b>1</b>       | <b>24</b>                  |

### **Brief Description about the course:**

The Signal and Systems Lab is an important component of the B.Tech (Robotics & Automation) curriculum, offered in the 3rd semester. This laboratory course plays a vital role in helping students comprehend how various systems respond to signals in both time and frequency domains. The primary aim of this lab is to explore real-world applications of signals and systems. Equipped with cutting-edge software and hardware, the lab enables students to extract valuable information from signals, particularly in the areas of signal processing and communications. Students utilize MATLAB software and its toolboxes to conduct simulations as part of their practical work in this lab.

### **LIST OF EXPERIMENTS**

1. Study of types of signals Deterministic and Stochastic (Continuous).
2. Study of time properties of signals.
3. Study of frequency properties of signal.
4. Study of stochastic properties of signal.
5. Study of discrete signals through MATLAB.
6. Basic properties of linear systems.
7. Study of impulse response of linear systems.
8. Analysis of MIMO SYSTEM (2-ports).
9. Study of Realization Theorem and Filters.
10. Simulation of systems using Op-amps/Software tools (MATLAB)

### **Course outcomes:**

CO1: Explain the fundamental principles of systems and how signals interact with physical systems.

CO2: Analyze signal frequency components and represent systems in the frequency domain using Fourier series and Transform techniques.

CO3: Utilize Laplace Transform and Z-Transform methods to examine LTI system responses.

CO4: Create various signal types and execute fundamental signal operations.

CO5: Comprehend different aspects of Fourier transform and Discrete Fourier Transform (DFT), which are suitable for MATLAB implementation due to their discrete nature in both time and frequency domains.

CO6: Examine the stochastic characteristics of signals.